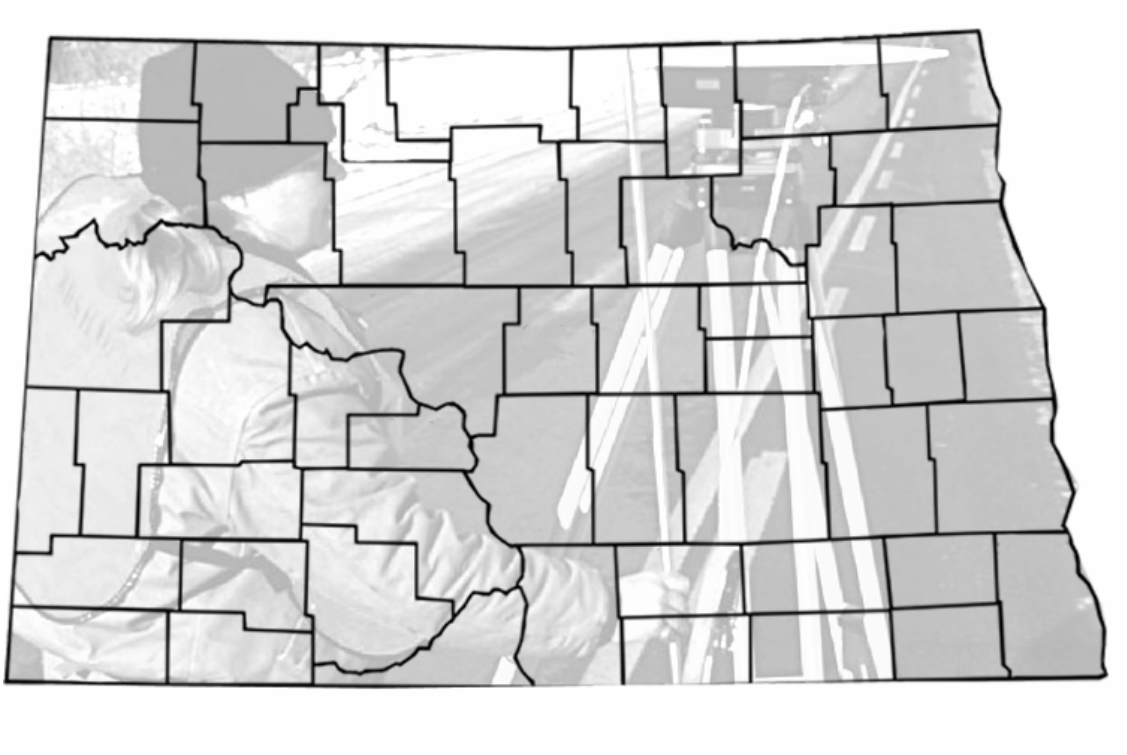
SCOPE OF WORK



FOR
CONSULTANTS PERFORMING
PRELIMINARY HIGHWAY SURVEYS

NOTE: This manual provides a written account of how certain activities are performed and is designed to guide and assist staff members in performing their functions.
When appropriate, there may be deviations from these written procedures due to changes in personnel, policies, interpretation, law, experimentation with different systems, or simply evolution of the process itself.

This manual may be changed at any time. Staff members are encouraged to review this manual periodically and suggest changes in the manual to keep the manual current and to minimize differences between the manual and actual practices.

JANUARY, 2006

19

CONSULTANT SERVICES

Second Edition
Date: March, 2001
Revised: 2/2/2006

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CONSULTANT SERVICES

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The following consultant service requirements are for all the reconstruction projects. The NDDOT uses aerial photography for collecting certain types of highway data. Therefore, this chapter refers to aerial methods of collecting this type of data. If the CONSULTANT is given the option to use field (ground) methods to collect this data, the same standards and area of coverage (survey corridor) apply. On small uncomplicated surveys, ground methods can be used instead of aerial photography. Some projects may have additional requirements that are not listed in this chapter. The scope of work will determine the sections of this document that will apply to each consultant.

The 90-1 (Safety surveys) requirements are defined in Chapter 18.

SERVICES TO BE PROVIDED BY CONSULTANT

19-1 SET PROJECT GROUND CONTROL

19-1.1 Project Control

The horizontal control shall be tied to the North Dakota coordinate system of 1983, north or south zone (be sure to use the correct zone), based on the North American Datum of 1983; (1996 Adjustment), NAD83 (CORS96) until the readjustment of the National Spatial Reference System (NSRS) is available. The readjustment is scheduled for completion February, 2007. The control will then be based on NAD 83 (NSRS).

The CONSULTANT shall set the PRIMARY CONTROL for the project by using a GPS survey to occupy pairs of monumented stations at both ends of the project and at intervals of every 2 to 3 miles throughout the project.

The Continuously Operating Reference Stations (CORS) will be used as the Master Control Network for all highway projects. The CORS stations used must surround (not all stations in a straight line or to one side) the project limits to prevent tilting of the coordinates and elevations. The CORS stations used as Master Control for the project will be picked from the following list:

BSMK	Bismarck, ND
MDR3	Medora, ND
CLK1	Clark, SD
PNR1	Pine River, MN
WHN1	Whitney, NE
BIL1	Billings, MN
WDLM	Wood Lake, MN

NOTE: other stations may be used if there are problems with the above stations.

The consultant shall use only geodetic grade Trimble GPS receivers (dual frequency, carrier-phase L1/L2) to collect all GPS data. A GPS receiver must occupy each PRIMARY CONTROL point for a MINIMUM of four (4) hours. This occupation time may be reduced in the future when NGS OPUS program is changed to provide the same accuracy level as the current four (4) hour accuracy (0.5 cm horizontally, 1.0 cm vertically).

The coordinates of the project control must be determined by using the NGS OPUS solutions.

The National Geodetic Survey operates the On-line Positioning User Service (OPUS) as a means to provide GPS users easer access to the National Spatial Reference System (NSRS).
OPUS allows users to submit their GPS data files to NGS, where the data will be processed to determine a position using NGS computers and software. Each data file that is submitted will be processed with respect to three (3) CORS sites.

NOTE: The coordinates must be based on the **International Foot** definition NOT the US Survey Foot definition.

It is important to have the correct antenna type and correct antenna height to the Antenna Reference Point. If this information is not correct, the elevations will be in error.
The project control network point coordinates are acceptable when the OPUS solution statistics are as follows:

There are three ephemeris levels

1. Ultra-rapid (predicted) orbits (near real time)
2. Rapid orbits (one day delay)
3. Precise orbits (typical delay 10-14 days) highest accuracy.

Do not use the "ultra-rapid" ephemeris. Use only the "rapid" or "precise" ephemeris.

Initially the OPUS program picks the CORS stations for its solution. This solution should be checked to see if the CORS sites surround the project and if the solution is the best one. The data files should be submitted again with other sites chosen to see if the solution can be improved.

Review the OPUS printouts for each point observed. If any of the following conditions are NOT met, the point(s) must be observed again.

1. Use 95% or more of your observations.
2. Fixed at least 95% of the fixed ambiguities.
3. Overall RMS should **seldom** exceed 1.5cm (0.015m). Maximum 1.8cm (0.018m).
4. The peak-to-peak errors should **seldom** exceed 3cm (0.030m). Maximum 4cm (0.040m). This includes the Orthometric height value [Geoid03 NAVD88].

NOTE: the peak-to-peak error is the difference between the maximum and minimum value of each coordinate obtained from the three baseline solutions.

The CONSULTANT shall be responsible for using GPS and/or conventional total station survey techniques to establish both an intervisible network of Secondary control stations within project limits, and to tie in all photo control points, horizontally and vertically. The Secondary control survey and photo control points shall be positioned relative to the PRIMARY CONTROL.

NOTE: No GPS data (targets, alignment, topography, utilities, etc.) shall be collected using the "**continuous Topo**" option. PDOP shall be set no higher then 6 (we prefer 5). No project GPS calibration is to be used.

19-1.2 Vertical Control

The vertical component of the survey shall be tied to the North American Vertical Datum of 1988 (NAVD 88).
The OPUS solution will be used to determine the elevation component of each PRIMARY CONTROL point. No levels will be run from existing Bench Marks to determine PRIMARY CONTROL elevations.

19-1.3 Monumentation

PRIMARY CONTROL stations shall be monumented with 3/4"diameter and at least 18" long, iron pins. Secondary control stations and photo control points shall be monumented with a 5/8" diameter or larger and at least 18" long, iron pins. All PRIMARY CONTROL stations and Secondary control stations must be referenced to at least three nearby features with horizontal tie distances. These reference ties shall be documented on a sketch, in the project survey book, for each monument. Both the state plane and ground coordinate values (X, Y, & Z) should be noted along side of these sketches.

19-2. ESTABLISH EXISTING HIGHWAY ALIGNMENT

19-2.1 Determination of Reference Point (RP) stationing

The beginning point of a survey is normally at or near the intersection of two highways. This point has a known Reference Point (**RP)** station. Locate or establish this intersection. If there are any other highway intersections on the PROJECT, locate or establish them. Each of these highway intersections have known **RP** stationing AHEAD of the intersection. Therefore, there will be an equation at each highway intersection. This equation is determined by measuring the distance from the last highway intersection. Contact NDDOT, Surveys & Photogrammetry for the correct RP stationing of highway intersections on or near the project.

19-2.2 Establish existing alignment

The existing alignment is established by locating existing PI's, POT's, curve points, and Public Land Survey system (PLSS) corners, using existing highway plans, right of way plats, city plats, and GLO plats. The alignment must be shown on the MicroStation/Geopak CADD drawings and the associated GPK file needs to be included.

19-2.3 Monumentation of existing alignment

Place an Iron Pin 5/8" or 3/4" in diameter and at least 18" long at all points that will be set on the survey centerline. This will include at least all PI's, PC's, PT's, TS's, and ST's. Section corners, Quarter corners, section line crossings, and quarter line crossings must be set by the procedure described in Section **19-7.**

19-2.4 Survey book requirements

In the project survey book, describe the method or methods used to establish the survey centerline alignment and sketch reference ties to all the above established points.

19-2.5 Coordinate system

Collect and record all alignment points in the "DOT county coordinate system" as defined in Section **19-15.**

19-3. AERIAL PHOTOGRAPHY DATA

19-3.1 AERIAL FLIGHTS (If requested)

19-3.1.1 Time of Day

Photography shall be taken when the sun angle is over 30 degrees above the horizon whenever possible. Photography shall be taken when the roadway is not obscured by shadows. Clouds and cloud shadows not to exceed one (1%) percent

19-3.1.2 Camera and Scale

19-3.1.2.1 Aerial Camera - Only 6" focal length with 9" x 9" format, precision cartographic single-lens camera equipped with a between-the-lens element shutter shall be used. The camera shall have a certification by the U.S. Geological Survey for aerial photography no older than 36 months from date of flight. A copy of the calibration report shall be sent with each completed project. The camera lens serial number on this calibration report shall agree with the serial number found on the auxiliary flight data recording. The camera shall be equipped with a vacuum or pressure device for holding the film flat at the instant of exposure.

19-3.1.2.2 Scale - The camera shall expose a 9" x 9" negative. The flight height above the average elevation of the ground shall be such that negatives will have an average scale of 1:3,600 (1"=300') for rural projects and 1:2,400 (1"=200') for urban projects. Negatives having an average departure from the average scale by more than five percent (5%) because of tilt or abrupt change in flying altitude shall be rejected.

19-3.1.3 Overlap

Forward lap of sixty five percent (65%) ±05% shall be maintained on all flight lines.

19-3.1.4 Exposures and Development

Negatives must be sharp in detail, of uniform medium density, free of light streaks, static marks or other defects.

19-3.1.5 Annotation of Negatives

Each negative shall be labeled clearly with the film-roll number, date of photography, project location, direction arrow, and negative number. The negative numbers shall be consecutive for the entire project.

19-3.1.6 Ownership of Materials

All original aerial photographic materials exposed in the performance of the work under this contract shall become the property of the ND Dept. of Transportation. The original aerial photography shall be left in rolls as exposed, in plastic containers, and delivered to NDDOT, Surveys & Photogrammetry Manager upon completion of this survey.

19-3.2 STEREOCOMPILATION OF MAPS AND DIGITAL TERRAIN MODELING (DTM's)

19-3.2.1 Model diagram

A model diagram indicating each model for the entire project shall be prepared on a USGS quadrangle base map. The beginning and ending exposure numbers of each flight line shall be indicated as well as every fifth exposure number within the flight line. The strip numbers shall also be labeled on the diagram parallel with the flight line and numbered consecutively starting with the first flight line flown. The title information on the diagram shall include: PROJECT number, PROJECT description, and highway number, and county, date of flight, roll number and calibrated focal length of camera. Label shall be oriented to comply with proper text placement and proper naming of files.

19-3.2.2 Stereocompilation

Stereocompilation of 3D Design Files (one for each flight line) recorded on DVD and compatible with Microstation "V8". The area to be compiled (survey corridor) will be a **minimum** of **three hundred feet** left and right of center line on all Rural and Urban projects. Surface features (asphalt edges, buildings, drains, culverts, etc.) shall be collected in a separate file from public land survey features (reference markers, right of way markers, etc.) DTM features (breaklines, mass points, and voids) will also be collected in a separate file. All data is to be collected in the "DOT County Coordinate System" as defined in Section **19-15**.

See Section **19-17 "MICROSTATION AND GEOPAK FILE NAMING CONVENTIONS"** for file naming conventions.

19-3.2.3 Current Seed files

The 2-D design files (CONTROL.dgn and 080_LO_001_COORDDATA.dgn) and 3-D Design Files (Togog.dgn and DTM.dgn) shall use the ***CURRENT*** NDDOT MicroStation seed files.
See Section **19-15.10** for the Web site location.

19-3.2.4 Feature attributes

All feature attributes shall follow NDDOT specifications as documented in the NDDOT CADD Drafting Standards Manual. See Section **19-15.10** for Web site location.

19-3.2.5 Planimetric details

All planimetric detail such as roads, driveways, sidewalks, trails, railroads, power poles, telephone poles, buildings, fences, wooded areas; and other identifiable features on the photography shall be shown in the Topog.dgn files in their correct positions and orientation. Hydrographic features such as lakes, streams and drainage lines shall also be shown at surface elevation. Individual trees with a diameter greater then eight (8") inches in the survey corridor, must be counted, the diameter measured, and recorded in the project survey book.

19-3.2.6 Names of roads

All roads shall be named in the files from information provided by the CONSULTANT.

19-3.2.7 Collecting Digital Terrain Modeling points

Digital Terrain Modeling (DTM) data is collected by stereo plotters and conventional field data collection techniques. The type of surface data collected, is the same in both cases. The density of the data collected is similar, with stereo plotter data being easier to collect.

The DTM data is collected in the stereo plotter using a mixture of "**break lines"**, "**spots"**, "**islands"**, and "**voids"**.

19-3.2.7.1 Break lines

Break lines are digitized from existing surface features like asphalt edges, concrete pads, field perimeters, dirt trails, berms, retaining walls, and curb and gutter. They are also digitized from observed changes in surface elevation that form distinct "edges". The drop off edge of a roadway ditch would be an example, or the bottom of the same ditch.

Other examples of when a breakline would be digitized are:

Flowline at the intersection of curb and gutter.
Crown of asphalt road.
Bottom of a curved concrete drainage channel.
Following the bottom of a natural drainage channel.
Perimeter of a slide area.

It is critical to ensure that no breaklines are allowed to cross one another. Post data collection editing must be performed, prior to extraction, to remove all crossing breaklines, otherwise the resultant 3-D model will be inaccurate.

Remember WHY you are creating the 3-D model. Does the designer need to have an accurate representation of the bridge deck and wing wall layout? If they do, you have to digitize not only the top of the wing walls but the ground at the base of the wing wall. It will also be necessary to bear in mind whether the terrain modeling will end at the structure, or be processed "under" the structure; should there be two versions created, to depict both situations?

Do not assume that a scaled custom line style will produce the desired results for your 3-D model. A custom line style for curb and gutter, that represents the back of curb, edge of curb, and edge of gutter, will only be "seen" as a single digitized line by the DTM extraction. Another example would be a railroad line style. If the plotter operator shoots down the middle of the tracks, that line string will serve as the only extractable breakline. The railroad "bed" will not become a part of the 3-D model, even though the line style looks like it is five feet wide.

19-3.2.7.2 Spot

Spot shots are normally shot in large areas of "like" elevations. Example: pasture land, arable fields, and football stadiums. They are shot to describe any slight undulations in a flat or rolling terrain. Spot shots are also taken to "fill in" areas between breaklines where the breakline data has the potential to heavily influence the triangulation of adjacent features.

As a rule of thumb, spot shots are rarely taken more than 30 feet apart. It is also recommended that spot shots are collected in a well spaced, non-stringed formation. If spots are colleted like cross sections (in line strings), the resultant Triangulated Irregular Network (TIN) will be compromised. The spot shot data should look like stars in the sky, rather than lines of data.

19-3.2.7.3 Islands

Islands are areas of breaklines and spot shots that get extracted as separate entities. The triangulated file data is not physically connected to the other triangles within the DTM model. Obviously islands within a lake, river, or pond would be extracted using this method. Another example would be multiple areas within a project where DTM data had been collected separately and the designer did not need any connection between these areas.

19-3.2.7.4 Voids

Voids are digitized areas, normally shot as closed shapes, around buildings or other structures, where the designer does not wish to have triangulation occur through the building or structure. Most contour maps inhibit the contours from drawing through structures or bodies of water. Typically voids are used around all bodies of water, wetlands, and buildings.

Using a combination of the above extraction features allows the NDDOT to supply the designers with very accurate ground representation and flexibility in future earth related applications. From accurate TIN file data, designers can cut cross sections, visualize survey centerline profiles, place proposed grade lines, compare post construction TIN's to preliminary survey TIN's, visualize perspective views, and much more. In order to fulfill these multiple adaptations, the **surface extraction procedures** need to be performed with high precision. Every ground deviation needs to be recorded using the correct feature code and Geopak extraction method. The TIN files need to be built with appropriate side lengths, so that no unwanted triangles are created, bridging undefined areas. And the resultant TIN files need to be thoroughly checked for crossing breaklines, erroneous data collection, duplicate features, and operator errors.

Digital Terrain Modeling (DTM) points shall be collected no more than 30 feet apart, at ground distance. Break lines shall be collected in a manner that creates an accuracy of plus or minus .10 feet vertically for ninety (90%) percent of the resultant data generated by the NDDOT's Geopak software being within 0.10 feet of ground truth when collected from 1:3,600 scale photography.

All TIN data needs to be checked thoroughly for errors and omissions. Approved methods for checking surfaces include:

- Generating temporary cross sections throughout the project corridor (every 25 feet).
- Rendering the surface model and applying light from various angles to observe surface deviations and
- holes.
- Generating centerline profiles along highways and side roads to check for road surface continuity.
- Creating contours throughout entire surface model to visualize surface ambiguities and "spikes."

The creation of contour lines, for the purpose of DTM extraction is not acceptable practice. The digitizing of contour lines is not required for NDDOT mapping and earthworks. Contours are only created from GeoPak.TIN files once the final surfaces are determined. Contour lines are not to be digitized in the stereo plotter or by field methods.

The TIN file sizes are to be kept to a manageable size.

Obviously, DTM data collected in the **field** with either GPS or conventional "total station" equipment is harder to collect. Great care needs to be taken in selecting the correct coding for data collectors, so that voids and figures are closed, and surface features get extracted correctly. There is also a much greater opportunity to accidentally cross breaklines when data is collected in the field. The field personal can not "see" previously recorded breaklines like the stereo plotter operator can. Multiple operators in the field may accidentally cross over one-another's work.

19-3.2.8 Delivery of DTM data

The DTM.dgn, 3-D MicroStation drawing, represents ONLY the features used to perform the final extraction to create the Digital Terrain Model (***.TIN file). NDDOT REQUIRES the submission of this .dgn file TOGETHER with the resultant .DAT and .TIN files.

19-3.3 CADD EDITING

The following items must be completed in the CADD editing process. This is not an all inclusive list.

19-3.3.1TRANSLATE stereoplotter files

CONTROL.DGN TOPOG.DGN DTM.DGN

19-3.3.2 CONTROL.DGN (2-D) (Contains PLSS information and alignment data)

19-3.3.2.1 Define alignment(s) using D & C Manager in the 2-D Control.dgn.

a. Curve definition table
Place on inside of curve.

b. Verify PI stationing
Verify that the location and station of plotted PI is correct. This should be the PI of the entire spiral curve, not just the circular portion of the spiral curve.

c. Tangent lines
Tangent lines should be drawn between beginning point of the curve, the PI, and the end point of the curve.

d. Swing ties for PC, PT, PI, POT, and Section line crossings
Use INSBAL cell for swing tie detail.
Swing tie text must be parallel with the alignment.
Tie line to point must be perpendicular to the alignment.
Tie line station text should be readable from right
Monumentation label is placed under tie line.
Section line crossing's tie bubble, tie labels, and station label, should take on the color of the Section (dark green), Township (orange), Quarter (Lt Gr.) crossing line.

e. All equation stations on alignments shall be labeled.

f. Check for Deflection angles
Any angle of deflection over 30 seconds shall be dimensioned.

g. Add any additional alignments
Add Existing Center Line of existing highway.
Dimension angle of intersection between multiple alignments.
h. Label all street names and highways.

19-3.3.3 PLSS INFORMATION CONTAINED WITHIN CONTROL.DGN

a. Section lines
Label section line crossing with PLSS information.
Label (to nearest hundredth) distance from alignment crossing to "recorded" Section corners.
Label Sec Twn & Rng at every section line crossing and every ½ mile throughout the project corridor.
Label obscured section lines SEC LINE (E.G. in the same location as alignment).
Any section line crossing not surveyed, should be placed 90degrees to back tangent.
Verify and label section corners as Recorded.

b. Points
Label ROW Monuments, reference markers, RTK points, Bench Marks, GPS points, and any other non-specific PLSS cells.

c. Label all Rivers, Lakes, canals, and Counties

19-3.3.4 TOPOG.DGN (3-D)

19-3.3.4.1 UTILITY DATA
a. Culverts
Copy culvert description to **bottom** 1050' area and leave a copy next to culvert.
b. Label Utilities
All utilities should be labeled for ownership. Using the CADD Manual appendix F, find the correct abbreviation and label all utility lines.
Make sure all line symbology and labeling reads from the bottom or the right.
Label utilities every ½ mile and wherever it crosses alignment.
c. Electric
Label lines with ownership, pairs, and size.
Verify direction of lines and guy wires (anchors on ground).
Ensure all overhead electric lines that cross survey centerline are shown on plans.
Delete duplicate items generated by both field and stereo plotter:
d. Gas\Fuel
Label lines with ownership, diameter, type, and pressure.
Verify direction of lines: (readability)
Delete duplicate items generated by both field and stereo plotter.
e. Signs
Verify if "signs" are: highway, private, utility markers, or just posts.
Rotate sign faces to correct orientation.
f. Sanitary
Place Sanitary lines at correct flow line elevation using field collected invert elevations.
Label lines with size, type, company, or if private.
Verify direction of lines (readability)
Delete duplicate items generated by both field and stereo plotter.
g. Miscellaneous
Label pedestals, manholes, boxes, and any "generic" cells.
Delete duplicate items generated by both field and stereo plotter:
h. Storm
Place Storm lines at correct flow line elevation using field collected invert elevations: *manhole cells remain at surface elevation.*
Label lines with size, type, and company.
Verify direction of lines:
Pipe culverts: See S & P help index for methods of labeling culvert sizes and location.
Shorten RCP culverts to compensate for flared end sections: ("C" distance)
Label invert elevations at each end of culvert
Recover bridge description data from NDDOT "Bridge listing".
Label bridge deck elevation at each end.
Box culverts have elevation labels at each end, on top.
Delete duplicate items generated by both field and stereo plotter**.**
i. Telephone
Label lines with size, type, and company label, pedestals, and manholes.
Verify direction of lines: (readability)
Delete duplicate items generated by both field and stereo plotter.

j. Television
Label lines with size, type, and company label, pedestals, and manholes.
Verify direction of lines: (readability)
Delete duplicate items generated by both field and stereoplotter.
k. Water
Label lines with size, type, and company label, manholes, pumps, and valves.
Verify direction of lines: (readability)
Delete duplicate items generated by both field and stereo-plotter.
l. Fiber Optic lines
Label lines with company, pairs, and types.
Verify direction of lines (readability)
Delete duplicate items generated by both field and stereo-plotter.

19-3.3.4.2 TOPOG

Label businesses and residences.
Label Curb and Gutter sizes
Label fence types.
Label all surface types.
Label Rail Roads by owner: (Dimension angle of RR crossing)

19-3.3.5 DTM

All data to be used for DTM extraction shall exit in the 3-D DTM.DGN file.

a. The extractable data will be a combination of DTM spots, DTM breaklines, DTM voids, and surface features, such as, concrete edges, field lines, asphalt, dirt, and curbs.
b. Any crossing breaklines need to be addressed and edited.
c. Extraneous triangle sides that fall outside of the surface features must be eliminated.
d. All void areas must be closed shapes.
e. All obscured areas, identified by compilers, must be addressed for completeness.
f. Two versions of the *.TIN file shall be produced to show any bridges in place and a version with the bridge structures removed.

19-3.3.6 WHATIZ DATA

During compilation, any features that have not been identified will have a “whatiz” cell digitized at that location. The CADD Editors need to obtain clarification from subsequent field data collection to ascertain the correct features and labeling. The “whatiz” cells may be rotated to improve visibility and additional comments added to explain what is needed. The “whatiz” cells should still fit within the “project corridor” width.

19-4. PERMISSION FOR ACCESS

Prior to any field surveys or targeting by the CONSULTANT, The CONSULTANT shall arrange for all permissions from private landowners to traverse on their property.

19-5. LOCATE PROPERTY CORNERS

When the highway project goes through or near a city or town, research and obtain plats of subdivisions and/or lots. Locate and tie in all private property (subdivision and lot corners) monuments within one block left and right of the survey centerline.

19-6. AIRPORTS

A notice of proposed construction must be filed with the Federal Aviation Administration on airports where the proposed construction meets the following:

1. Any construction of more than 200 feet in height above ground.
2. Any proposed construction that enters an imaginary line that extends from a point 200 feet from the end of the nearest airport runway, upward and outward at one of the following slopes:
   - A. Slope 100:1 for a horizontal distance of 20,000 feet (3.8 miles) with the length of runway more than 3,200 feet.
   - B. Slope 50:1 for a horizontal distance of 10,000 (1.9 miles) feet with a length of runway not more than 3,200 feet.
   - C. Slope 25:1 for a horizontal distance of 5,000 feet from the nearest point of a heliport.
3. Complete FAA Form 7460-1 if any of the above conditions are encountered on the project. Attachments to the form are required. One attachment is the source of the coordinate information and reference datum.

Any airport (Public or Private) within two miles of the project must be tied in to the survey centerline as follows:

19-6.1 Runway centerline alignment

Extend the centerline of the airport until it intersects the survey centerline. Monument and record the coordinates (in state plane X, Y, & Z, and Latitude & Longitude) of this point on the centerline.
If the airport is PARALLEL to the highway, the above intersection point determination requirement does not apply, but the items listed below are needed.

NOTE: A Registered Land Surveyor must complete a certification document.
See Section **19-21** or contact NDDOT Surveys and Photogrammetry, telephone # 701-328-2640 for sample surveyor's airport certification document.

19-6.2 Other requirements defined

Measure and record the following information in the project survey book:

1. Record the distance from the near end of the runway to the survey centerline.
2. Record the width of the runway.
3. Record the elevations of the near end of the runway (the centerline and both corners).
4 Record the coordinates of both the near and far ends of the runway in state plane X, Y, & Z, and Latitude & Longitude.

19-7. LOCATE PUBLIC LAND SURVEY SYSTEM (PLSS) CORNERS

Locate and tie in the PLSS (Section, quarter, etc.) Corners, on survey centerline and left and right of the survey centerline crossings. These points must show up in the MicroStation CADD drawing (CONTROL.DGN).

19-7.1 Corner search

Search for physical evidence at each site, including making excavations as appropriate, to look for monuments, or the features with which to substantiate the location of each corner.

19-7.1.1 Set monument and cap

Set monument and LS CAP at corners located but not already monumented (follow Century Code NDCC 47-20.1).

19-7.1.2 Corner recordation

Prepare and record "***Corner Recordation"*** forms on each PLSS Corner with the County Recorder. Provide the NDDOT, Surveys & Photogrammetry with a copy of each corner recordation form (in .PDF format).

19-7.2 Section and quarter line crossings

Determine each section and quarter line crossing the survey centerline. This point must be in line with the PLSS corners right and left of centerline. These are alignment related points.

19-7.3 Section and quarter line monumentation

Set a 3/4" diameter and at least 18" long, iron pin monument at each section and quarter line crossing of the survey centerline. On section lines that cross a curve, the monument shall be placed on the tangent line of the curve, not on the curve itself.

19-7.4 Information in survey book

Measure reference ties and sketch this information in the project survey book.

NOTE: All of Section **19-7** must be done by, or under the guidance of, a ND Registered Land Surveyor.

19-8. REFERENCE MARKERS

Record the coordinate location of all Reference Marker posts (formerly called mile posts) on this project and supply the coordinate (Northing & Easting) data on the 080LO_001_COORDDATA.dgn sheet as shown in Section **19-20**. These points must also show up on the MicroStation CADD drawing (CONTROL.dgn).

19-9. TIE RIGHT OF WAY MARKERS/MONUMENTS

Locate and record the coordinate location of any right of way markers and right of way monuments found on the project. These will be digitized in the CONTROL.DGN file.

19-10. SIGN SURVEY

Complete sign inventory forms for all business and State signs within the survey corridor.

Measure and record the location of all the above signs.

Take at least one original photograph of each sign. Try to show the sign from base to face.

Use SFN 50455 (3-00) "***Traffic control sign inventory"*** form for State signs.

Use SFN 13793 (4-94) "***Signs within present right of way"*** forms for private business signs.

Assemble the forms and photographs into a sign survey forms book. Sign cells should also appear in the TOPOG.dgn file.

19-11. LOCATE UNDERGROUND UTILITIES

Locate and record all underground utilities (water, sewer, gas, electric, fiber optic cables, telephone, etc.). These points must show up on the MicroStation CADD drawing (TOPOG.dgn).

See Section **19-17 "MICROSTATION AND GEOPAK FILE NAMING CONVENTIONS"** for file naming convention.

1. Record name, size, and type of utility, if possible, in the project survey book.
2. Measure and record elevation of all water main and gate valves within the survey corridor.
3. Record the invert elevation, size, type, and condition of each pipe in all sanitary and storm sewer manholes. Also the rim, ring elevations, and number of rings in all manholes.
4. Sketch the direction of each pipe, entering a manhole, in the project survey book.
5. Measure and record the location, invert elevation, size and type of all culverts within the existing highway right of way or survey corridor. All measurements should be made at the outlet of the pipe. Also note if the culvert has flared ends.
6. Record notes on utility contacts, "Name, Telephone number, and date of contact" in the project survey book

19-12. RAILROAD CROSSINGS

Locations, descriptions, and details required at railroad crossings include:

19-12.1 Railroad equation

The plus shall be taken to the nearest hundredth of a foot at the inside of both rails.
Also determine the railroad equation. Example: Highway centerline **RP** station = railroad centerline station. The railroad stationing can be determined from RR right of way or station to station plats.

19-12.2 Railroad profile

Get elevation profiles (centerline and top of each rail) down the RR track 1000 feet left and right of highway centerline.

19-12.3 Crossing type

Dimensions and type of crossing (wood plank, asphalt, concrete plank, etc.) shall be recorded in the survey book. Location and type of crossing protection (signals, gates, cross bucks, etc.) shall also be recorded in the survey book.

19-13 BRIDGE (HYDRAULIC) SURVEY DATA

For any structures located on the project, the NDDOT Bridge Division needs the following minimum survey data to assist in their hydraulic analysis:

1. Complete the Bridge Survey Report form (SFN 3853).
   A sample copy of the Bridge Survey Report form is located in Section **19-19**.
2. Upstream profile
   Beginning at the upstream end of the existing structure, take and record profile shots along the thread of the stream, every 100 feet or less, going upstream 1000 feet.
3. Downstream profile
   Beginning at the downstream end of the existing structure, take and record profile shots along the thread of the stream, every 100 feet or less, going downstream 1000 feet.
4. Typical upstream cross section
   Take a typical cross section somewhere between 500 feet and 1000 feet upstream to adequately cover the flood plain. This may require a cross section of 1000 feet or more in length.
5. Typical downstream cross section
   Take a typical cross section somewhere between 500 feet and 1000 feet downstream to adequately cover the flood plain. This may require a cross section of 1000 feet or more in length.
6. Structure site typical stream section
   Take a typical profile section on both sides of the existing structure.
7. Centerline profile
   Take a profile of the highway centerline through the flood plain.

19-14 DIGITAL HAND HELD CAMERA

When a digital camera is used to take project related hand held pictures (such as: signs, drainage structures, and bridges etc.), the camera must have the following specifications:

The picture should be good quality and have a picture resolution of 2.0 million pixels. A sensor resolution of at least 896 X 592 pixels. Color of 24-bit, million colors. A picture file format of JPEG.

19-15. PROJECT COORDINATES SYSTEM AND OTHER DATA

19-15.1 Project coordinates

Reference all project coordinate data to the NDDOT "(County name) County Coordinate System".
Table of factors is shown in Section **19-16**.
This system is based on the North Dakota Coordinate System NAD 83(CORS96), north or south zone.

If the project extends into another county, normally the data file stops 1000 feet ahead into the second county. A new data file is started with 1000 feet shown from the first county.
Example: A project starts in Walsh County and extends into Pembina County. In the Walsh County portion show 1000 feet of data into Pembina County using Walsh County coordinates. In the Pembina County portion show 1000 feet back into Walsh County using Pembina County coordinates.

19-15.2 Data collection

Collect coordinate values for all field points in a Data Collector, using the ***SDR33 format***. Each point shall have a unique point number. Plus the Northing, Easting, point code, and point description of the point.
Point numbers 1-99 shall be used only for alignment points (control).
Point numbers 100-299 for targets,
300 – 399 for calculations,
400 – 499 for additional points,
and 500 – 5999 plus 20,000 and above shall be used for all other points.
The "***NDDOT data collection codes"*** document shall be used for all data collection. This document is available from NDDOT, Surveys and Photogrammetry. The codes are also in the Standards Manual which is available on the Web site.

19-15.3 Length measurements

The International Foot definition shall be used for all data point coordinates and measurements.

19-15.4 Alignment accuracy

All measured survey alignment horizontal coordinate values and distances shall be accurate to " 0.10'.

19-15.5 Coordinate accuracy

All measured horizontal coordinate values and distances (except survey alignment) shall be accurate to " 0.20'.

19-15.6 Vertical accuracy

All measured elevation values shall be accurate to " 0.10'.

19-15.7 Coordinate sheet

Complete the "**COORDINATE AND CURVE DATA"** sheet(s) for the PROJECT (MicroStation drawing file "080LO_001_COORDDATA.dgn").

19-15.8 Completion of MicroStation/Geopak CADD drawings.

Relevant information gathered in the survey books must be included in the CADD drawings. This includes, but is not limited to, the following items:

Survey centerline in **RP** stationing, stereo plotter data collected in 19-3.2, all culvert data, PLSS points, section line crossings points, reference ties to all alignment-related points, section-township-range data, curve data, underground utility data, airport data, reference marker locations, railroad data, right of way data, property corners and property lines.

A sample copy of the NDDOT CADD drawings, showing correct placement of data, is available from NDDOT, Surveys & Photogrammetry.

19-15.9 Original survey data

Upon **completion** of the survey, all data and original books will become the property of NDDOT.

19-15.10 Format standards

All data will be submitted in the following formats and/or standards:

1. Trimble data collector files	(*.dc)
2. NDDOT data collection codes and procedures.	(EFB field data)[1].
3. NDDOT Reference point stationing procedures.	(**RP** stationing).
4. Word	(All word processing files).
5. Microstation "V8"	(For plan sheet data).
6. Geopak "2004"	(For plan sheet data).
7. NDDOT CADD Drafting Standards	(For plan sheet data)[1].
8. NDDOT ***CURRENT*** MicroStation seed files.	(For plan sheet data)[1].
9. ASCII txt files	(for AAreadme & ASCII point files)

[1] All necessary resource files and standard files are maintained on NDDOT Web site "www.state.nd.us/dot/caddmanual.html".

19-16. DELIVERY OF SURVEY DATA

Immediately upon completion of this survey, the following items must be sent to the NDDOT, Surveys and Photogrammetry Manager:

1. All **original** survey books created.
2. Electronic data collected, computed, and drawn as a result of this survey, on DVD, along with a letter of transmittal, listing the file names on the DVD's and a description of the information they contain.
3. Electronic data shall contain a Geopak ".gpk" file that contains the COGO definition of the alignment.
4. All GPS and conventional horizontal and vertical control survey notes shall be submitted.
5. **Original** aerial negatives in spooled container.
6. **Original** completed sign survey forms book.
7. Plats obtained as requested in Section **19-5.**
8. Copy of completed surveyors' certification as required in Section **19-6**.
9. Copy of recorded "***Corner Recordation"*** forms for all PLSS corners used in this survey.

19-16.1 **SPECIAL CASES**

The Surveys & Photogrammetry Manager must approve any departure from, or modification to, the minimum specifications.

19-17 MICROSTATION AND GEOPAK FILE NAMING CONVENTIONS
Microstation V8

(ATLAS) Stereoplotter data FOLDER
(NDDOT purposes only)

AAREADME.TXT - - - - - *Text file describing contents of folder.*
DTM.ATL - - - - - - - - - *DTM spots, breaklines, etc., shot in stereo plotter.*
TOPOG.ATL- - - - - - - - - *Topographic ground and Utility features.*

(EFB) Field Survey Data Collection folder

AAREADME.TXT - - - - Text file describing contents of folder.
JOB001.GPK - - - - - - - - Geopak data file. Contains control for alignment definition Plus all points imported through Survey Manager.
EFB_CONTROL.DGN - [3-D] Section corner, property lines/corners, R/W data. Survey centerline, curve data, swing ties.
EFB_TOPOG.DGN - - - - [3-D] Final Edit of surface features; roadways, buildings, signs, posts, utilities, drains, culverts, water, wetlands, etc.
EFB_DTM.DGN - - - - - - [3-D] Extractable features, including mass points, breaklines, voids, edges of roadways, concrete surfaces, edges of water, etc.
ASCII sub folder - - - - - - Contains ASCII text versions of the data collector information.

(SURVEY) Plan & volumetric Info folder

AAREADME.TXT - - - - Text file describing contents of folder.
JOB001.GPK - - - - - - - - Copy of EFB original .GPK file. Contains control for alignment definition plus all points imported through Survey Manager.
080LO_001_ COORDDATA.DGN - - - - - - [2-D] Coordinate data sheet containing alignment coords, survey point data, sec cor locations, GPS points etc.
CONTROL.DGN - - - - - [2-D] Section corner, property lines/corners, R/W data. Survey centerline, curve data, swing ties.
TOPOG.DGN - - - - - - - - [3-D] Final Edit of surface features; roadways, buildings, signs, posts, utilities, drains, culverts, water, wetlands, etc.
DTM.DGN - - - - - - - - - - [3-D] Extractable features, including mass points, breaklines, voids, edges of roadways, concrete surfaces, edges of water, etc.
*****.DAT** - - - - - - - - - - Points file created from DTM extraction.
*****.TIN** - - - - - - - - - - Triangulation file built from DAT file.

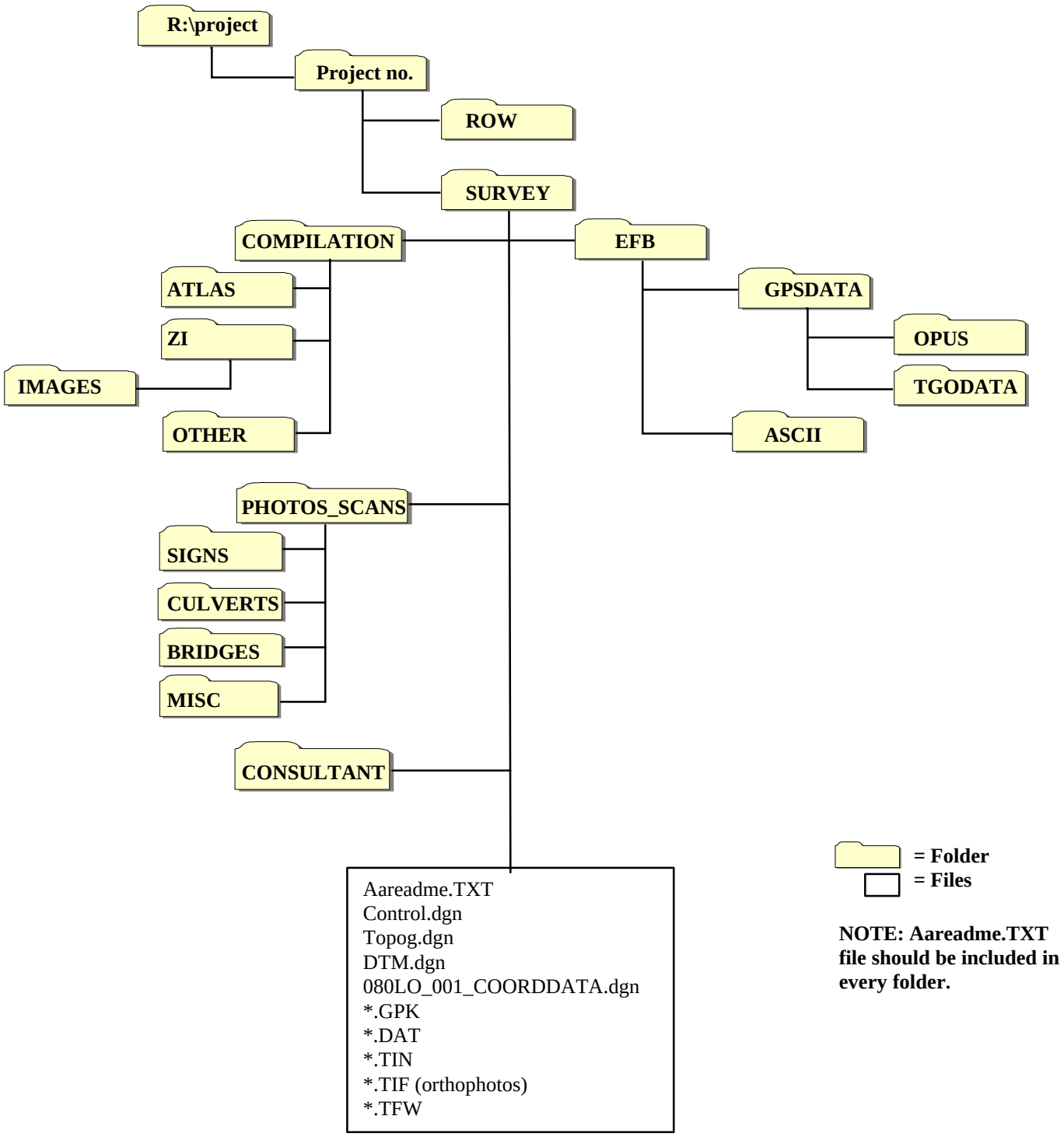
(ROW) Right of way plats folder

AAREADME.TXT - - - - Text file describing contents of folder and daily status and/or explanation of unique information concerning plats or information obtained.
RP#.DGN - - - - - - - - - - The right of way plats.
RS#.DGN - - - - - - - - - - The supplement sheet to the plat.
######.DOC - - - - - - - - - All text files inserted for recording (Legal Desc.)
RW_bndry.DGN - - - - - - Proposed right of way areas (just the lines).
EX_bndry.DGN - - - - - - Copy of the SP_Bndry.DGN file.
EX_Align.DGN - - - - - - - Copy of the SP_Align.DGN file.
jobROW.GPK - - - - - - - GPK file used for storing any data dealing with the new or proposed right of way. (Can copy the GPK file from the EFB folder and rename it jobROW.GPK the original boundary points and alignment points are in it. Many of the unnecessary points: i.e. – topog, earth, and utility points can be deleted).

NOTE: See following pages for one county and two county folder flow charts.

19-17 MICROSTATION AND GEOPAK FILE NAMING CONVENTIONS (Cont.)

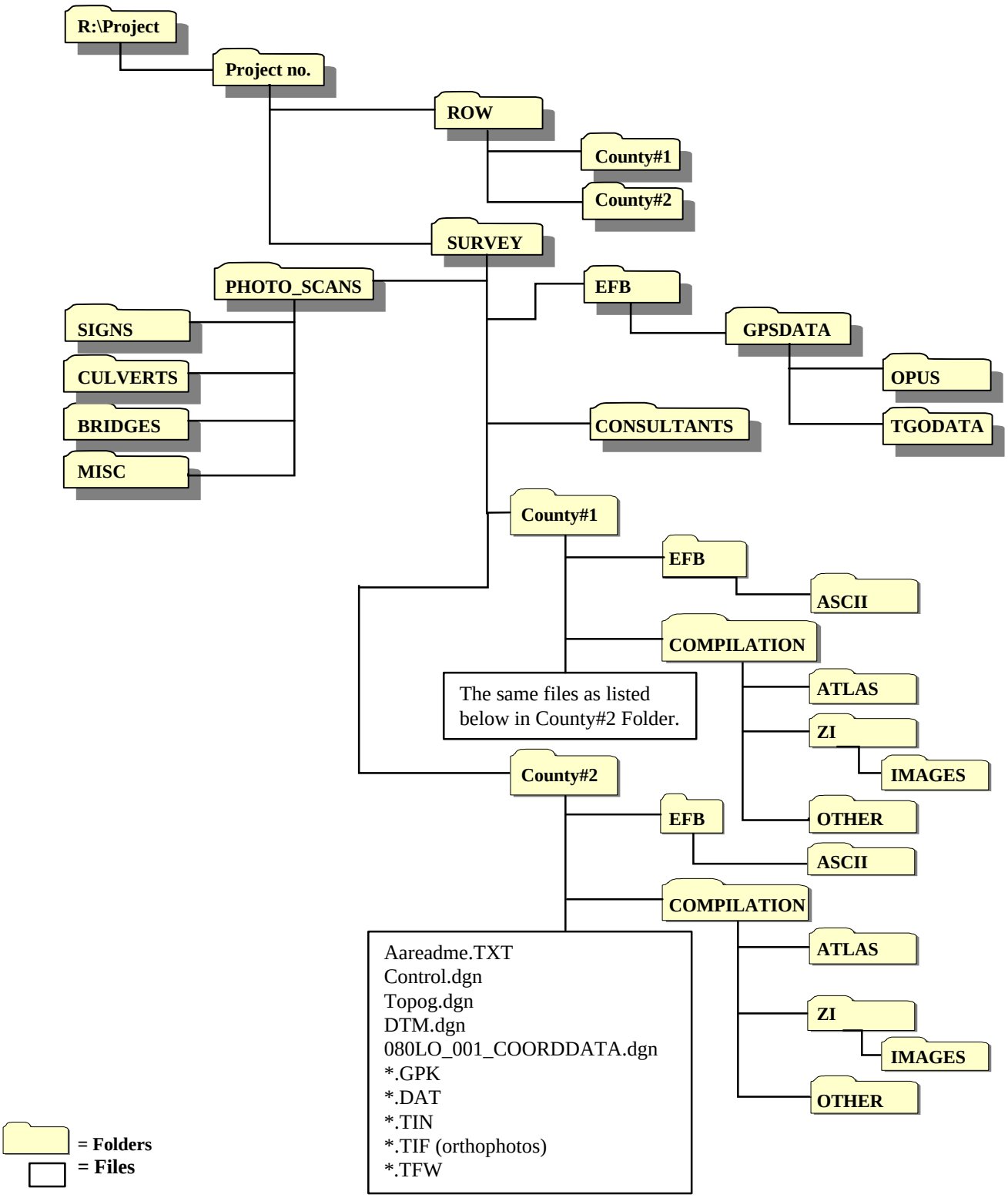
Microstation V8 (Flow chart for project in one county)



NOTE: Aareadme.TXT file should be included in every folder.

19-17 MICROSTATION AND GEOPAK FILE NAMING CONVENTIONS (Cont.)

Microstation V8 (Flow chart for project in two or more counties)



NOTE: Aareadme.TXT file should be included in every folder.

19-18 DOT COUNTY COORDINATE CONVERSION FACTORS

ND LAMBERT STATE PLANE COORDINATE SYSTEM 83

The NDDOT county conversion factor is used to determine ground (horizontal **not vertical**) distances from grid distances.It is also used to reduce ground (horizontal **not vertical**) distances to the state plane grid. A county conversion factor (average) has been determined for each county in North Dakota.
These factors are listed in the DOT COUNTY COORDINATE CONVERSION FACTORS table and map.

The factors can be used to convert a distance or a coordinate from the grid to ground or from ground to grid.

DISTANCE EXAMPLE:
A project is located in Burleigh County. The Burleigh County conversion factor (cf) is 0.9998515.
The 1/cf factor is 1.0001485221.

1. To determine the ground distance from the grid distance. Divide the grid distance by the Conversion Factor.

The distance on the grid is 5279.22 feet.
What is the ground distance?

5279.22 / 0.9998515 = 5280 feet
The ground distance is 5280 feet.

2. To determine the grid distance from a ground distance. Multiply the ground distance by the conversion factor.

The distance on the ground is 5280 feet.
What is the grid distance?

5280 * 0.9998515 = 5279.22 feet
The grid distance is 5279.22 feet

NOTE: One (1) divided by the conversion factor will provide a ground factor that when multiplied by the grid distances will determine the ground distances.

5279.22 * 1.0001485221 = 5280 feet

COORDINATE EXAMPLE:
A project is located in Burleigh County. It has the same conversion factors as the example above.

1. To determine the ground coordinates (DOT Burleigh County Coordinate System) from the grid coordinates.
Multiple the grid coordinates by 1.0001485221.

Grid Coordinates * Burleigh County conversion factor (1/cf) = Ground coordinate
421,173.7664 N * 1.0001485221 = 421,236.3200 Y
1,889,225.8327 E * 1.0001485221 = 1,889,506.4245 X

2. To determine the grid coordinate (State Plane coordinate) from the ground coordinates.
Multiple the ground coordinates by 0.9998515.

Ground coordinate * Burleigh County conversion factor (cf) = Grid coordinate (state plane-South Zone)
421,236.3200 Y * 0.9998515 = 421,173.7664 N
1,889,506.4245 X * 0.9998515 = 1,889,225.8328 E

19-18.1 DOT COUNTY COORDINATE CONVERSION FACTORS

ND LAMBERT STATE PLANE COORDINATE SYSTEM 83

State Plane Coordinate (or grid distance) = Ground Coordinate (or distance) times cf
Ground Coordinate (or distance) = State Plane Coordinate (or grid distance) times 1/cf

NORTH ZONE

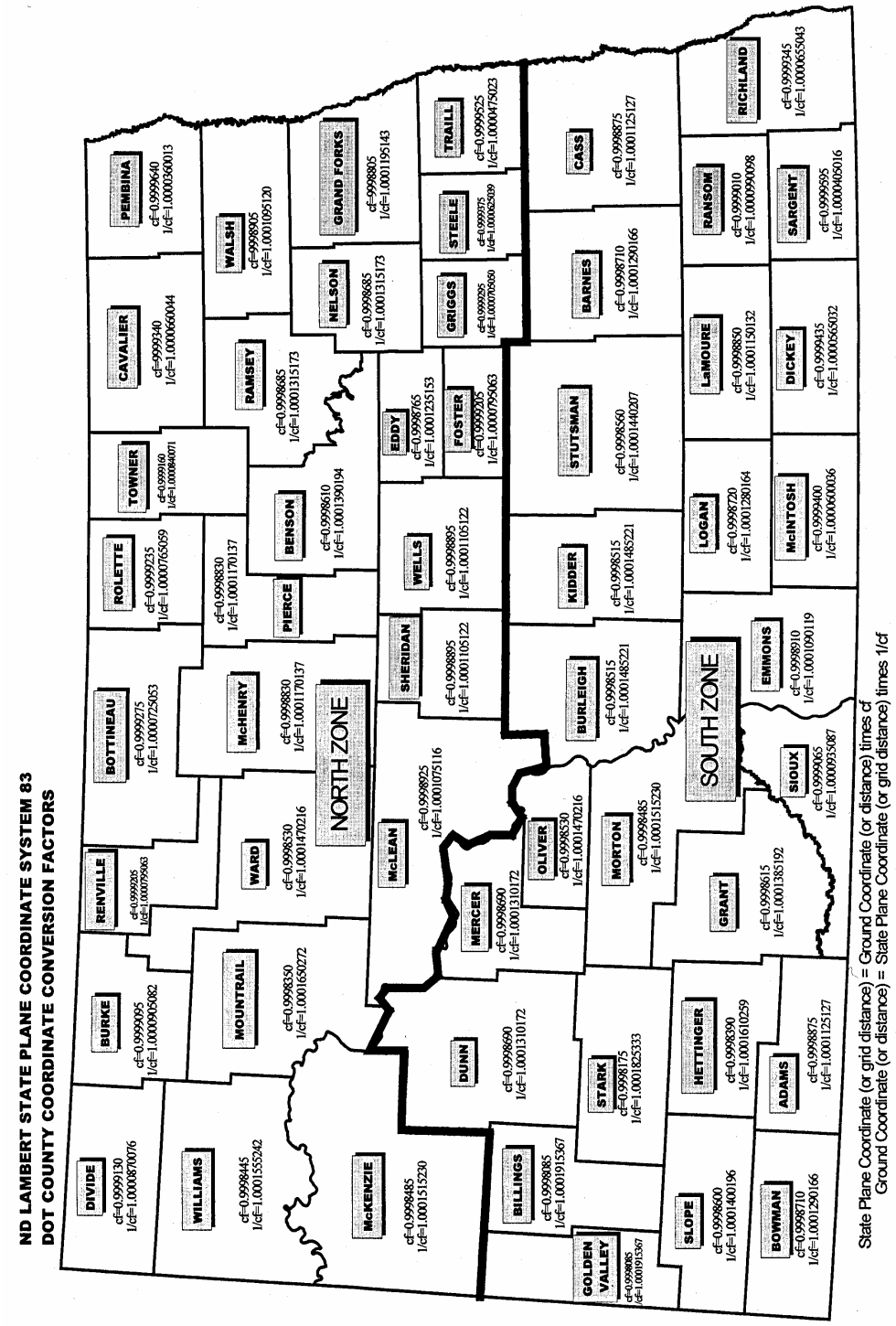
COUNTY	COUNTY COMBINATION FACTOR (cf)	1/cf
Benson	0.9998610	1.0001390194
Bottineau	0.9999275	1.0000725053
Burke	0.9999095	1.0000905082
Cavalier	0.9999340	1.0000660044
Divide	0.9999130	1.0000870076
Eddy	0.9998765	1.0001235153
Foster	0.9999205	1.0000795063
Grand Forks	0.9998805	1.0001195143
Griggs	0.9999295	1.0000705050
McHenry	0.9998830	1.0001170137
McKenzie	0.9998485	1.0001515230
McLean	0.9998925	1.0001075116
Mountrail	0.9998350	1.0001650272
Nelson	0.9998685	1.0001315173
Pembina	0.9999640	1.0000360013
Pierce	0.9998830	1.0001170137
Ramsey	0.9998685	1.0001315173
Renville	0.9999205	1.0000795063
Rolette	0.9999235	1.0000765059
Sheriden	0.9998895	1.0001105122
Steele	0.9999375	1.0000625039
Towner	0.9999160	1.0000840071
Traill	0.9999525	1.0000475023
Walsh	0.9998905	1.0001095120
Ward	0.9998530	1.0001470216
Wells	0.9998895	1.0001105122
Williams	0.9998445	1.0001555242

SOUTH ZONE

COUNTY	COUNTY COMBINATION FACTOR (cf)	1/cf
Adams	0.9998875	1.0001125127
Barnes	0.9998710	1.0001290166
Billings	0.9998085	1.0001915367
Bowman	0.9998710	1.0001290166
Burleigh	0.9998515	1.0001485221
Cass	0.9998875	1.0001125127
Dickey	0.9999435	1.0000565032
Dunn	0.9998690	1.0001310172
Emmons	0.9998910	1.0001090119
Golden Valley	0.9998085	1.0001915367
Grant	0.9998615	1.0001385192
Hettinger	0.9998390	1.0001610259
Kidder	0.9998515	1.0001485221
LaMoure	0.9998850	1.0001150132
Logan	0.9998720	1.0001280164
McIntosh	0.9999400	1.0000600036
Mercer	0.9998690	1.0001310172
Morton	0.9998485	1.0001515230
Oliver	0.9998530	1.0001470216
Ransom	0.9999010	1.0000990098
Richland	0.9999345	1.0000655043
Sargent	0.9999595	1.0000405016
Sioux	0.9999065	1.0000935087
Slope	0.9998600	1.0001400196
Stark	0.9998175	1.0001825333
Stutsman	0.9998560	1.0001440207

19-18.2 DOT COUNTY COORDINATE CONVERSION FACTORS (Map)

ND LAMBERT STATE PLANE COORDINATE SYSTEM 83



19-19 SAMPLE COPY OF BRIDGE SURVEY REPORT FORM (Page 1)

BRIDGE SURVEY REPORT
North Dakota Department of Transportation, Bridge
SFN 3853 (Rev. 11-2000)

Bridge No.	
Project No.	

County	Section	Township	Range
Bridge Over	Route (Highway No.)		
Surveyed by	Date		

EXISTING STRUCTURE

Type ☐ Truss ☐ Steel girder ☐ Concrete girder ☐ Slab ☐ Box culvert ☐ Timber girder ☐ Other			
Year Built	Structure Position ☐ Normal ☐ Skew	Size (Span Arrangement And Total Length)	
Bridge Deck or Roadway Elevation Begin Br. End Br.		Station Begin Br. End Br.	
Low Point in Roadway, If Not at Structure		Elevation of Clearance Line	
Culvert's Invert Elevation at inlet at outlet		Waterway Opening Below Clearance Line	
Scour Location		Depth	Length / Width

COMMENTS

FIELD SUGGESTIONS FOR OFFICE PLANNING OF NEW STRUCTURE

Provide channel profile 1,000 feet upstream and 1,000 feet downstream. For bridges, provide channel section at upstream and/or downstream edge of bridge. Obtain stream sections preferably 100 feet to 500 feet both upstream and downstream. Select locations that represent typical stream sections.

OTHER STRUCTURES ACROSS SAME STREAM	NO. 1	NO. 2
Location of structure		
Railroad or highway crossing		
Kind of structure		
Number and length of spans		
Total waterway opening		
Extent of scour at crossing		
Distance from stream bed to clearance line		
Does size of structure appear to be adequate?		

Other Comments

19-19 SAMPLE COPY OF BRIDGE SURVEY REPORT FORM (Page 2)

HISTORICAL FLOOD DATA

Maximum Known Stage	Date of Maximum Stage	
How Long Was this Stage at or near Maximum?	Location of Maximum Stage ☐ Upstream ☐ Downstream ☐ Unknown	
Head Differential Between Upstream and Downstream Ft. ☐ Unknown	Stage Affected by ☐ Ice ☐ Debris ☐ Dams ☐ Other	
Water Overtop Roadway ☐ Yes ☐ No Comment:	If Yes, Depth and Length of Section Overtopped Depth Length	
Was the above Stage Exceptional or Have Other Stages Been near the Maximum Stage?		
Elevation or Depth of Extreme Low Water	Source of Information	
Where Does Source Live?	How Long?	Did Source Personally Observe Maximum Stage? ☐ Yes ☐ No
Other Comments		

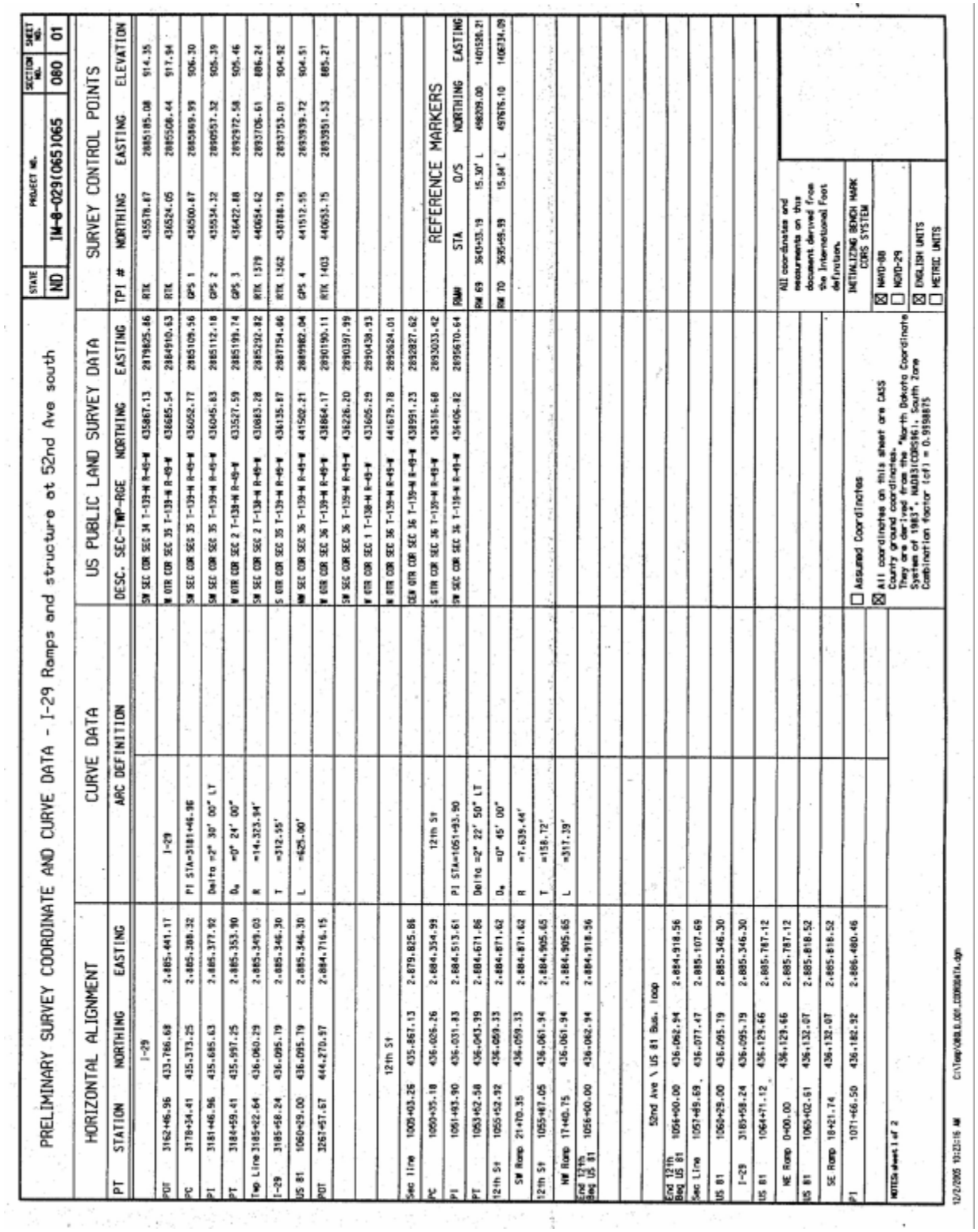
HISTORICAL FLOOD DATA

Maximum Known Stage	Date of Maximum Stage	
How Long Was this Stage at or near Maximum?	Location of Maximum Stage ☐ Upstream ☐ Downstream ☐ Unknown	
Head Differential Between Upstream and Downstream Ft. ☐ Unknown	Stage Affected By ☐ Ice ☐ Debris ☐ Dams ☐ Other	
Water Overtop Roadway ☐ Yes ☐ No Comment:	If Yes, Depth and Length of Section Overtopped Depth Length	
Was the above Stage Exceptional or Have Other Stages Been near the Maximum Stage?		
Elevation or Depth of Extreme Low Water	Source of Information	
Where Does Source Live?	How Long?	Did Source Personally Observe Maximum Stage? ☐ Yes ☐ No
Other Comments		

HISTORICAL FLOOD DATA

Maximum Known Stage	Date of Maximum Stage	
How Long Was this Stage at or near Maximum?	Location of Maximum Stage ☐ Upstream ☐ Downstream ☐ Unknown	
Head Differential Between Upstream and Downstream Ft. ☐ Unknown	Stage Affected by ☐ Ice ☐ Debris ☐ Dams ☐ Other	
Water Overtop Roadway ☐ Yes ☐ No Comment:	If Yes, Depth and Length of Section Overtopped Depth Length	
Was the above Stage Exceptional or Have Other Stages Been near the Maximum Stage?		
Elevation or Depth of Extreme Low Water	Source of Information	
Where Does Source Live?	How Long?	Did Source Personally Observe Maximum Stage? ☐ Yes ☐ No
Other Comments		

19-20 SAMPLE COPY OF COORDINATE AND CURVE DATA SHEET



PRELIMINARY SURVEY COORDINATE AND CURVE DATA - I-29 Ramps and structure at 52nd Ave south

STATE: ND | PROJECT NO.: IM-0-029(065)065 | SECTION NO.: 060 | SHEET NO.: 01

HORIZONTAL ALIGNMENT				CURVE DATA	US PUBLIC LAND SURVEY DATA			SURVEY CONTROL POINTS				
PT	STATION	NORTHING	EASTING	ARC DEFINITION	DESC. SEC-TWP-RGE	NORTHING	EASTING	TPI #	NORTHING	EASTING	ELEVATION	
	I-29											
POT	3162+46.96	433,786.68	2,885,441.17	I-29	SW SEC COR SEC 34 T-139-N R-49-W	435867.13	2879825.86	RTK	435578.67	2885185.08	914.35	
					W QTR COR SEC 35 T-139-N R-49-W	436685.54	2884910.63	RTK	436524.05	2885508.44	917.94	
PC	3178+24.41	435,373.25	2,885,388.32	PI STA=5181+46.96	SW SEC COR SEC 35 T-139-N R-49-W	436652.77	2885109.56	GPS 1	436500.67	2885869.99	906.30	
					SW SEC COR SEC 35 T-139-N R-49-W	436045.83	2885112.18	GPS 2	435934.32	2890557.32	905.39	
PI	3181+46.96	435,685.63	2,885,377.92	Delta =2° 30' 00" LT	W QTR COR SEC 2 T-138-N R-49-W	435527.59	2885199.74	GPS 3	436422.88	2892972.58	905.46	
PT	3184+59.41	435,997.25	2,885,353.90	D_a =0° 24' 00"	SW SEC COR SEC 2 T-138-N R-49-W	430883.28	2885292.82	RTK 1379	440654.62	2893706.61	886.24	
Two Line	3185+22.64	436,060.29	2,885,349.03	R =14,323.94'	S QTR COR SEC 35 T-139-N R-49-W	436135.87	2887754.66	RTK 1362	436788.79	2893753.01	904.32	
I-29	3185+58.24	436,095.79	2,885,346.30	T =512.55'	NW SEC COR SEC 36 T-139-N R-49-W	441502.21	2889982.04	GPS 4	441512.95	2893939.72	904.51	
US 81	1060+29.00	436,095.79	2,885,346.30	L =629.00'	W QTR COR SEC 36 T-139-N R-49-W	438864.17	2890190.11	RTK 1403	440653.75	2893951.53	885.27	
POT	3251+57.67	444,270.97	2,884,716.15		SW SEC COR SEC 36 T-139-N R-49-W	436226.20	2890397.39					
					W QTR COR SEC 1 T-138-N R-49-W	431605.29	2890438.93					
	12th St				W QTR COR SEC 36 T-139-N R-49-W	441679.78	2892624.01					
Sec Line	1009+03.26	435,867.13	2,879,825.86		SE QTR COR SEC 36 T-139-N R-49-W	438991.23	2892827.62					
PC	1059+35.18	436,025.26	2,884,354.99	12th St	S QTR COR SEC 36 T-139-N R-49-W	436316.68	2893033.42	REFERENCE MARKERS				
PI	1061+93.90	436,031.83	2,884,513.61	PI STA=1051+93.90	SW SEC COR SEC 36 T-139-N R-49-W	435406.82	2895670.64	RAM	STA	O/S	NORTHING	EASTING
PT	1063+62.58	436,043.39	2,884,671.86	Delta =2° 22' 50" LT				RM 69	3643+33.19	15.30' L	498209.00	1401526.21
12th St	1065+52.92	436,059.33	2,884,871.62	D_a =0° 45' 00"				RM 70	3695+69.39	15.84' L	497616.10	1406734.09
SW Ramp	21+10.35	436,059.33	2,884,871.62	R =7,639.44'								
12th St	1065+67.05	436,061.94	2,884,905.65	T =156.72'								
NW Ramp	17+40.75	436,061.94	2,884,905.65	L =317.39'								
End 12th Beg US 81	1056+00.00	436,062.94	2,884,918.56									
	52nd Ave \ US 81 Bus. Loop											
End 12th Beg US 81	1054+00.00	436,062.94	2,884,918.56									
Sec Line	1057+69.69	436,077.47	2,885,107.69									
US 81	1062+29.00	436,095.19	2,885,346.30									
I-29	3183+58.24	436,095.19	2,885,346.30									
US 81	1064+71.12	436,129.66	2,885,787.12									
NE Ramp	0+00.00	436,129.66	2,885,787.12									
US 81	1065+02.61	436,132.07	2,885,818.52									
SE Ramp	18+21.74	436,132.07	2,885,818.52									
PI	1071+66.50	436,182.32	2,886,480.46		☐ Assumed Coordinates			INITIALIZING BENCH MARK CORS SYSTEM				
					☒ All coordinates on this sheet are CASS County ground coordinates. They are derived from the "North Dakota Coordinate System of 1983", NAD83(CORS96), South Zone Combination factor (cf) = 0.9998875			☒ NAVD-88 ☐ NGVD-29 ☒ ENGLISH UNITS ☐ METRIC UNITS				
								All coordinates and measurements on this document derived from the International Foot definition.				

NOTES: sheet 1 of 2

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19-21 COPY OF SURVEYORS "AIRPORT CERTIFICATION DOCUMENT"

North Dakota Department of Transportation
608 East Boulevard Avenue • Bismarck, ND 58505-0700

Edward T. Schafer, Governor
Tom D. Freier, Director

Information: (701) 328-2500
FAX Mail: (701) 328-4545
TTY: (701) 328-4156
Website: http://www.state.nd.us/dot/

SURVEYOR's CERTIFICATION June 07, 2000

PROJECT **NHU-2-052(017)265** 1st STREET IN JAMESTOWN
A survey was made to determine the coordinate position (Latitude and Longitude) and elevation of a point (Station 14033+95.12 **RP**) on US# 52 (1st STREET) in Jamestown, ND. The point is where the Jamestown Municipal airport runway centerline extended, intersect US#52.

Coast & Geodetic Survey triangulation stations "**JOHNSON**", "**SYDNEY**", and "**MUD**" were used to control the horizontal coordinates. GPS equipment, GPSurvey software, and a Total Station were used to determine the coordinates of this point.

The calculated coordinates for the point (Station 14033+95.12 **RP**) are as follows:

I certify that the Latitude and Longitude for the point listed below is within ± 15 feet horizontally.

Station 14033+95.12 Latitude 46° 54' 34.00" N Longitude 98° 42' 30.67" W

Elevation for the point (within 3 feet vertically) is as listed below.

Station 14033+95.12 1412 feet AMSL

The horizontal datum (coordinates) are in terms of the North American Datum of 1983 (NAD 83) and are expressed as degrees, minutes, and seconds.
The vertical datum (heights) are in terms of the National Geodetic Vertical Datum of 1988 (NAVD) and are determined to the nearest foot.

SIGNED:
DeLane R. Meier
North Dakota Land Surveyor # ND 1139

DeLANE R. MEIER
REGISTERED
LAND
SURVEYOR
1139
NORTH DAKOTA